HY-40Q101 Bluetooth Low Energy Module (40 pin)

For AEC-Q100 Automotive Specifications

01 Dec. 2018

Version：V1.0

Version History

Version	Revision Date	Reviser	Reviewer	Revised Contents
V1.0	2018/12/01	GKL	LYC	1st issue

CONTENTS

1. Description:

HY-40Q101 Bluetooth low energy single mode module is for AEC-Q100 Qualified Automotive Applications , Automotive Device Specification Temperature Grade 2: (–40°C to +105°C), HY-40Q101 is a single mode device, targeted for low power energy sensors and accessories. HY-40Q101 offers all Bluetooth low energy features: radio, stack, profiles and application space for automotive applications. The module also provides flexible hardware interfaces to connect sensors. HY-40Q101 can be powered directly with a standard 3V coin cell batteries or pair of AAA batteries. in lowest power shutdown mode it consumes only 0.15uA and will wake up in few microseconds. HY-40Q101 transmission distance of 80 meter or more. (At face to face, free space, 1.2 Meter high from Ground for testing, depend on Antenna gain & Antenna efficiency).
Bluetooth IC：TI CC2640R2F-Q1 7*7*1.0mm 48pin IC

2.Applications:

2-1:. Automotive Applications:
Car Access
Keyless Entry
Passive Entry/Passive Start (PEPS) Systems
Car Sharing
Piloted Parking
Wireless Onboard Diagnostics (OBD)
Cable Replacement
Remote Control
Sensors

2-2:.Industrial applications:
Logistics
Production and Manufacturing Automation
Asset Tracking and Management
HMI and Remote Display
Access Control

3.KEY FEATURES:

- Bluetooth v4.2 and v.5.0 single mode hardware compliant
- Supports master, slave and master / slave modes
- Integrated Bluetooth low energy stack
- GAP, GATT, L2CAP, SMP Bluetooth low energy profiles
- Compliance Bluetooth BQB BLE 4.2 and 5.0, And Compliance worldwide RF Regulations. Example: China 3C, Europe CE ETSI RED, America FCC, Canada IC, Japan TELEC, Korea KC…etc.
- IC Transmit power :+5 dBm typical
- IC Receiver sensitivity: -97dBm typical
- Ultra low current consumption : Standy by mode : 3.6uA (with Cache RTC, CPU, RAM and partial register retention).
- Shutdown mode:. No clocks running, no retention: 150 nA (Typical)
- Programmable ARM Cortex-M3 processor for embedding full applications

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4. Product model Number: Hardware Model Description (3 kinds Antenna type for choice)

	Product Name	Product Mode Item	Description
1	HY-40Q101PC	WMD40Q101xx6PC	PCB IFA Antenna with shield case
2	HY-40Q101IC	WMD40Q101xx6IC	IPEX Connector for External Antenna with shield case
3	HY-40Q101CC	WMD40Q101xx6CC	Ceramic Antenna with shield case

5. PCBA dimension size and picture   (PCBA dimension size : (25.16* 15.22* 2.6 mm).

5-1: HY-40Q101PC (PCB IFA Antenna, with shield case);
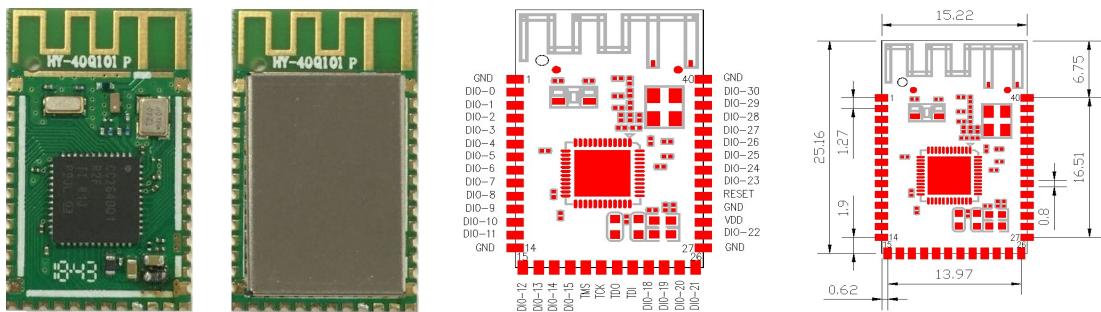
5-2:HY-40Q101IC (IPEX RF connector with shield case)
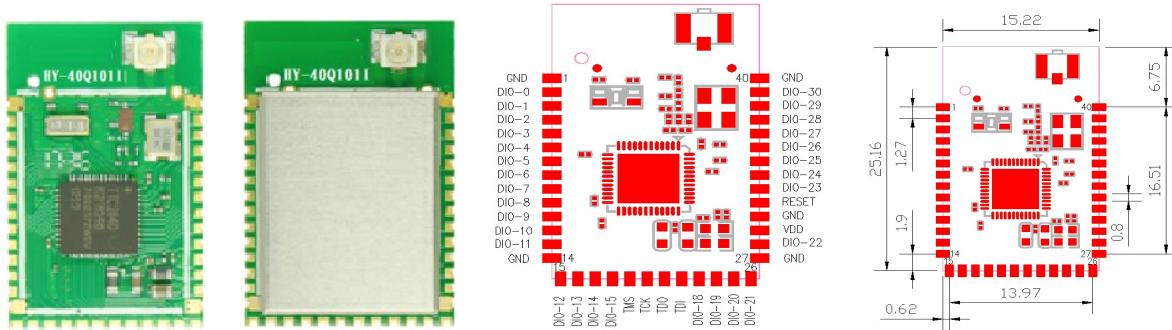
5-3: HY-40R201CC (Ceramic Antenna, with shield case) ;

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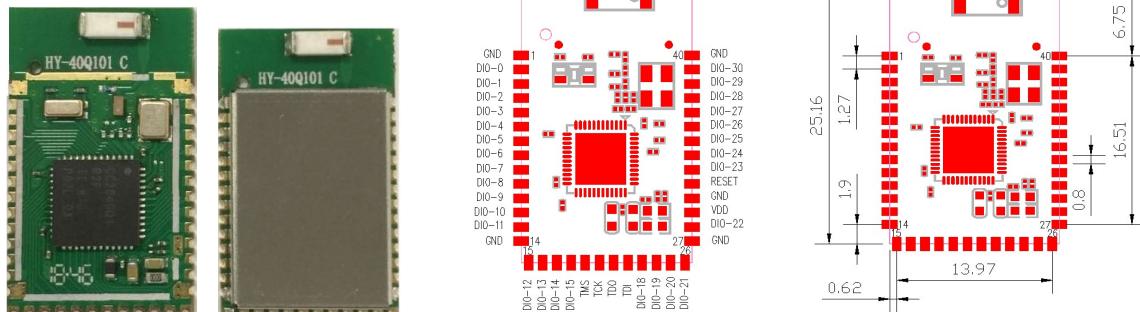
6.Application Note:

6-1. Attention to the electrostatic protection, prevent the soldering iron and the equipment grounding bad; And the workbench, working environment,packaging materials and from the human bodyTouch with static electricity… etc., destroy IC and software be fly; Manual welding module solder iron temperature, should pay attention to avoid the PCB copper stripping off; Soldering iron strictly Grounding requirements, eliminating iron power failure module;

6-2. Attention! The mainboard must had Over-voltage protective circuit, to avoid the mainboard power supply circuit had bad welding connected short or open, and when power supply instant turn on / turn off ..etc , Let the provide Bluetooth chip VCC had abnormal voltage, To causing the software will flied and IC was damaged.

6-3. When programming firmware, the VDDS supply voltage must in DC 2.4~3.3V, To avoid programming has not completely, and abnormal status occur..

6-4. Avoid supply voltage in (BOD Brown - Out Dectect) fall within the scope of electrical detection threshold (1.76 V ~ 1.78 V) occurred many times, (diagram below off electric Lock - up area) firmware may be locked.
Cause the Boot Code startup Code suspended, unable to connect to the JTAG protocol,;In case of this state is available use Reset pin action under 1.0 V, to remove this phenomenon; The rechargeable batteries at charge-discharg status; In the application at the same time, to ensure the voltage setting of the protection system; And pay attention to the supply of power caused by the internal resistance and line impedance voltage drop; And make sure that The equipment operating voltage from 1.8 V to 3.8 V, and ensure that the voltage slope faster than 0.5 V/ms (through BOD threshold).
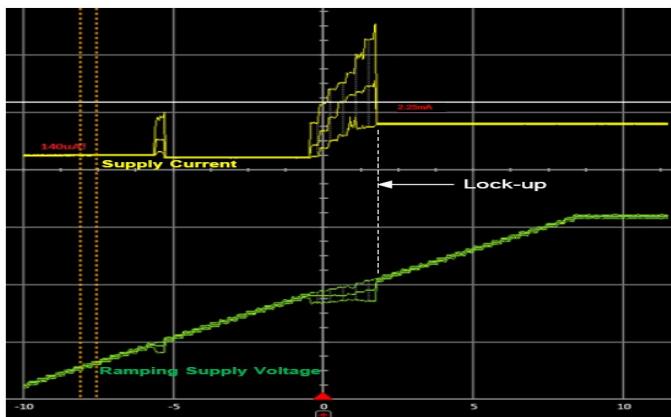
6-5. Use the module in the production and the transport process, please insure module's component protection, prevent the precision parts on the module damaged (soldering reflow exit and assembly, testing, delivery process, suggest using collision buffer material, not collide with each other)

6-6. The module for the humidity sensitive components, if used in SMT reflow soldering operations, please strictly follow the IPC/JEDECJ - STD – 020 regulation, completes the drying dehumidifying , and for this module had second processing work after placed in the functional test environment, the humidity of the chip is no guarantee that in a certain ratio, the honored guest please understand;   (The attention note show in below Fig.)

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6-7. The diagram (show in below Fig.) of the module application on external filter parts, when need, please design in the mainboard, the parts parameter can depend on the actual need to changes.
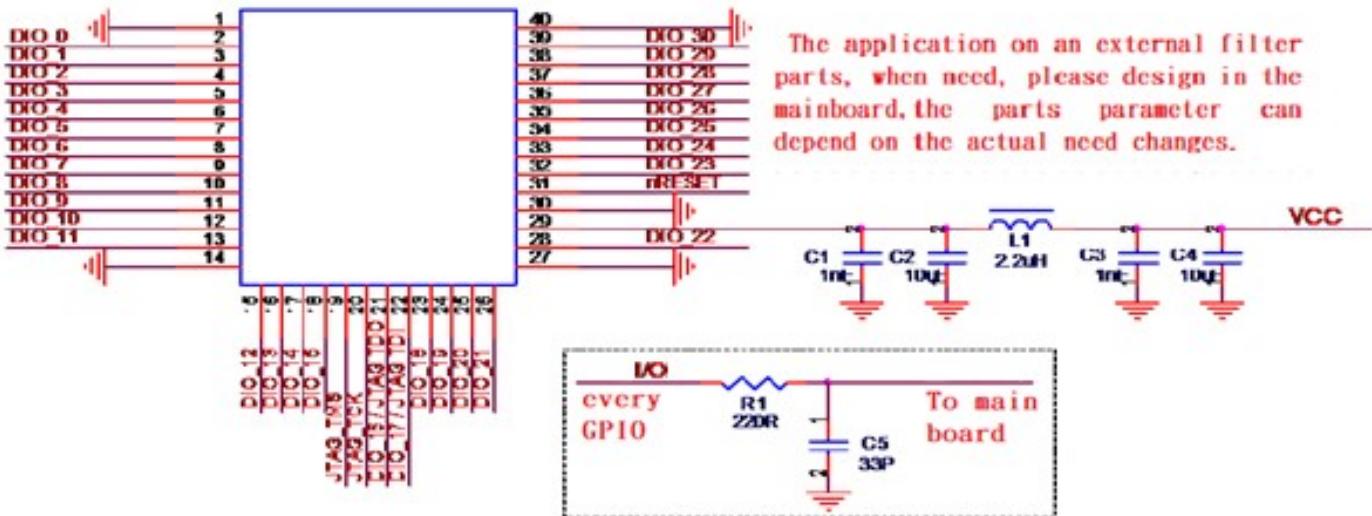
6-8. Assembly recommendation 1: Underneath the module antenna and RF circuit on the main board PCB copper need to clearance, and place close to the main board edge, as show in below Fig.
The antenna can't be near around metal parts and prevent material existence of electromagnetic radiation , Can affect the manipulation of the distance.

6-9. Assembly recommendation 2: Signal trace and power supply trace, don't cross layout, as show in below Fig.To avoid crosstalk, affect the receiving sensitivity.

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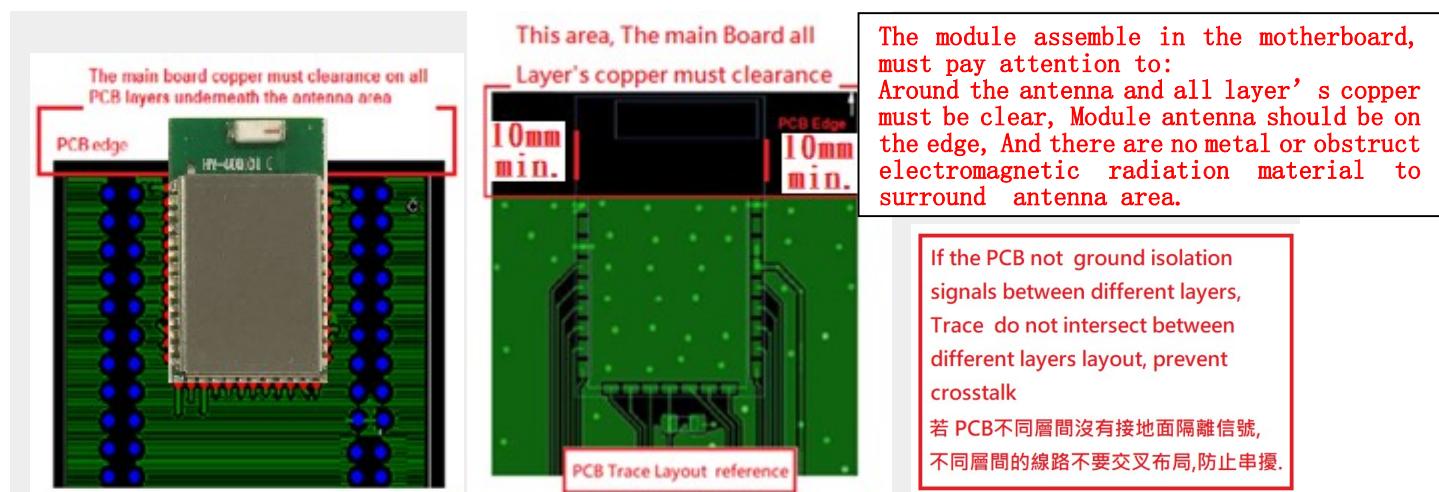
7. Pinout and GPIO function Description

Pin	Name	Type	Function Description
1	GND	Power GND	Ground
2	DIO_0	Digital I/O	GPIO, Sensor Controller (I:4mA max)
3	DIO_1	Digital I/O	GPIO, Sensor Controller (I:4mA max)
4	DIO_2	Digital I/O	UART RX; GPIO, Sensor Controller (I:4mA max)
5	DIO_3	Digital I/O	UART TX; GPIO, Sensor Controller (I:4mA max)
6	DIO_4	Digital I/O	WAKE UP; Don't floating GPIO, Sensor Controller (I:4mA max)
7	DIO_5	Digital I/O	GPIO, Sensor Controller, high-drive capability (8mA max).
8	DIO_6	Digital I/O	GPIO, Sensor Controller, high-drive capability (8mA max).
9	DIO_7	Digital I/O	GPIO, Sensor Controller, high-drive capability (8mA max).
10	DIO_8	Digital I/O	GPIO (I: 4mA max)
11	DIO_9	Digital I/O	GPIO (I: 4mA max)
12	DIO_10	Digital I/O	GPIO (I: 4mA max)
13	DIO_11	Digital I/O	GPIO (I: 4mA max)
14	GND	Power GND	Ground
15	DIO_12	Digital I/O	GPIO (I: 4mA max)
16	DIO_13	Digital I/O	GPIO (I: 4mA max)
17	DIO_14	Digital I/O	GPIO (I: 4mA max)
18	DIO_15	Digital I/O	GPIO (I: 4mA max)
19	JTAG TMSC	Digital I/O	JTAG TMSC; high-drive capability
20	JTAG TCKC	Digital I/O	JTAG TCKC
21	DIO_16 TDO	Digital I/O	GPIO,JTAG_TDO; high-drive capability(8mA max).
22	DIO_17 TDI	Digital I/O	GPIO,JTAG_TDI; high-drive capability(8mA max).
23	DIO_18	Digital I/O	GPIO (I: 4mA max)
24	DIO_19	Digital I/O	GPIO (I: 4mA max)
25	DIO_20	Digital I/O	GPIO (I: 4mA max)
26	DIO_21	Digital I/O	GPIO (I: 4mA max)

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27	GND	Power GND	Ground
28	DIO_22	Digital I/O	GPIO (I: 4mA max)
29	VDD	Power Supply	+1.8V to +3.8V (Recommended 2.7~3.3V)
30	GND	Power GND	Ground
31	RESET	Digital input	Reset, active-low. Module have pull up.
32	DIO_23	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
33	DIO_24	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
34	DIO_25	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
35	DIO_26	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
36	DIO_27	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
37	DIO_28	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
38	DIO_29	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
39	DIO_30	Digital I/O	GPIO, Sensor Controller, Analog(I: 4mA max)
40	GND	Power GND	Ground

8. Electrical Characteristics

(Test condition: With Ta = 25 ℃, VDD =3.0V with internal DC-DC converter, standardmeasure:1Mbps GFSKmodulation ,FRF = 2440MHz Bluetooth Low energy mode.)

8-1.Radio performance & current consumption

(Test condition:With Ta = 25 ℃, VDD =3.0V, with internal DC-DC converter, standardmeasure:1Mbps GFSKmodulation ,FRF = 2440MHz Bluetooth Low energy mode.)
  ➢ Modulation Mode: GFSK
  ➢ Frequency range: 2402~2480MHZ (2.4GHz ISM band)
  ➢ Transmit power setting Range: -21 ~ +5 dBm typical (differential mode o/p point characteristics ; programmable by software)
  ➢ Receiver sensitivity: -97dBm typical(differential mode o/p point characteristics)
  ● Ultra low current consumption
  ➢ Transmit：7.0mA(typical)（TX O/P Power setting :0dBm）
  ➢ Transmit：9.3mA(typical)（TX O/P Power setting :5dBm）
  ➢ Receive(high gain setting): 6.1 mA(typical)
  ➢ Idle. Supply Systems and RAM powered:650uA(Typical)
  ➢ Standby. With Cache, RTC, CPU, RAM and partial register retention. XOSC_LF: 3.6 uA(Typical)
  ➢ Shutdown. No clocks running, no retention: 150 nA(Typical)

8-2. Absolute Maximum Ratings

Note: These are absolute maximum ratings beyond which the module can be permanently damaged, these are not Maximum operating conditions, the maximum recommended operating conditions are in the table 6.

Rating	Min	Max	Unit

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VDDS	-0.3	3.8	V
Other Terminal Voltages	VSS-0.3	VDDS+0.3	V
Storage Temperature	-40	+125	°C

8-3. ESD Ratings

			Value	Unit
V_{ESD}Electrostatic discharge	Human Body Model (HBM), per AEC Q100-002(1) (2)	All pins	±2000	V
	Charged Device Model (CDM), per AEC Q100-011(3)	XOCS pins 46, 47	±250	
		All other pins	±500	

(1) AEC Q100-002 indicates HBM stressing is done in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

(2) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(3) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

8-4. Recommended Operating Conditions

Supply voltage noise should be less than 10mVpp. Excessive noise at the supply voltage will reduce the RF performance.

Rating	Min	Max	Unit
VDD (when BlueTooth Active)	1.8	3.8	V
VDD(when flash programming)	2.4	3.3	V
Operating Temperature Range	-40	+85	°C

Note:

(1).VDD power supply recommended voltage : 2.7~3.3V

(2).When programming firm ware , the VDD supply voltage must in DC 2.4~3.3V,

   To avoid programming has not completely, or abnormal status occur..

(3).For smaller coin cell batteries, with high worst-case end-of-life equivalent source resistance, a 22-µF VDDS input capacitor must be used to ensure compliance with this slew rate(8-6 timing req.).

8-5.GPIODC Characteristics

Parameter	Test Condition	Typical	Unit
GPIO VOH at 8-mA load	IOCURR = 2, high-drive GPIOs only	2.68	V
GPIO VOL at 8-mA load	IOCURR = 2, high-drive GPIOs only	0.33	V
GPIO VOH at 4-mA load	IOCURR = 1	2.72	V
GPIO VOL at 4-mA load	IOCURR = 1	0.28	V

8-6. Timing Requirements

Description	MIN	NOM	MAX	UNIT
Rising supply-voltage slew rate	0		100	mV/uS
Falling supply-voltage slew rate	0		20	mV/uS
Falling supply-voltage slew rate, with low-power flash settings(1)			3	mV/uS

| RESET_N low duration		1			uS

(1) For smaller coin cell batteries, with high worst-case end-of-life equivalent source resistance, a 22-μF VDDS input capacitor must be used to ensure compliance with this slew rate.

8-7. Switching Characteristics

Measured with Tc = 25°C, VDDS = 3.0 V, unless otherwise noted.

| Parameter	Test Condition	Min	Typical	Max	Unit
Wakeup and Timing					
Idle →Active			14		μs
Standby →Active			151		μs
Shutdown →Active			1015		μs

9. Block Diagram
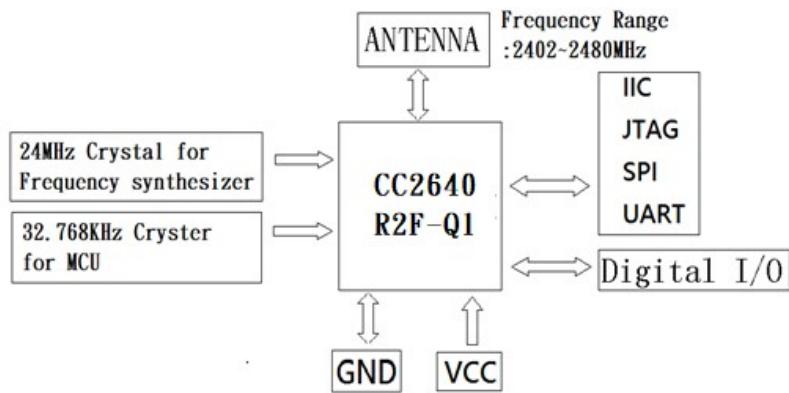
10. Functional Block Diagram

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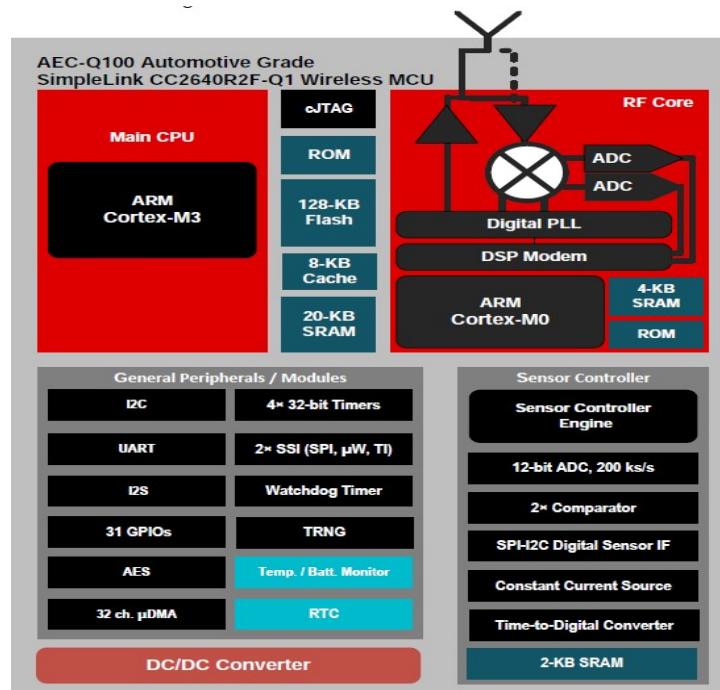
11. Working mode schematic
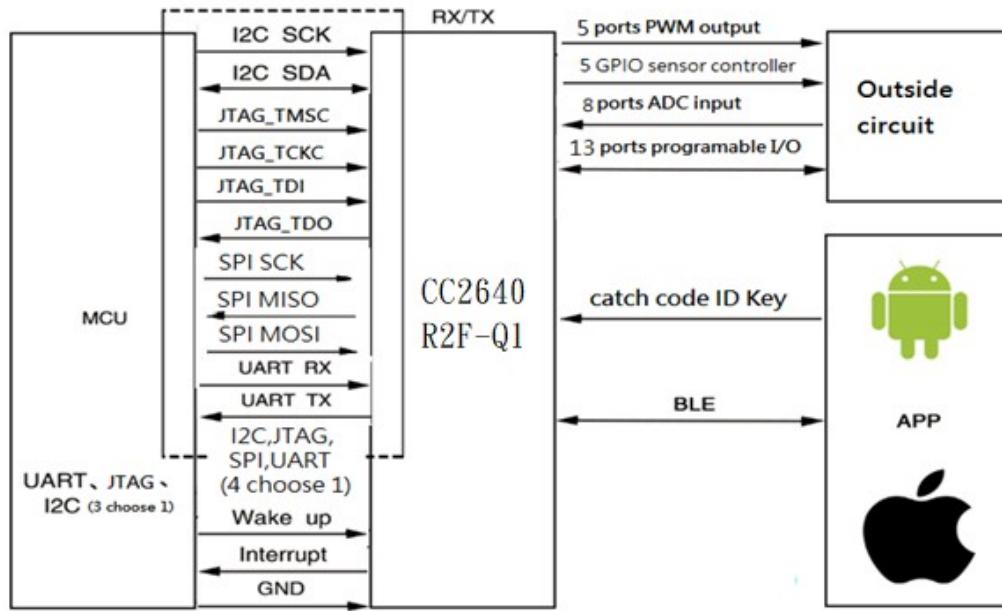
12. Recommend Reflow Profile(Leadless solder cream: Sn 96.5%, Ag 3%, Cu 0.5%)

Profile Feature	Pb-Free Assembly	
	Large Body	Small Body
Average ramp-up rate(T_L to T_P)	3°C/second max	
Preheat-Temperature Min (Ts_{min}) -Temperature Max (Ts_{max}) -Time (min to max)(ts)	150°C 200°C 60-180 seconds	
$Ts_{max}$to T_L-Ramp-up Rate	3°C/second max	
Time maintained above-Temperature (T_L) -Time (t_L)	217°C 60-150 seconds	
Peak Temperature (T_P)	245 +0/-5°C	250 +0/-5°C
Time within 5°C of actualPeakTemperature (t_p)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max	
Time 25°C to PeakTemperature	8 minutes max	

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Reflow Curve Classification
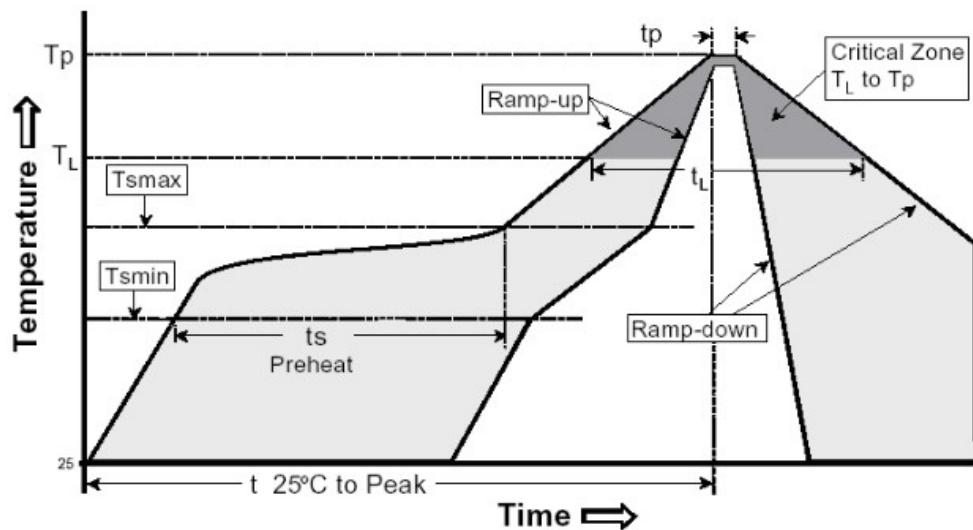
13.Contact Us

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